THIRD INTERIM REPORT

OF THE

PLANNING SUBCOMMITTEE

OF THE

FCC ADVISORY COMMITTEE

ON

ADVANCED TELEVISION SERVICE

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EXECUTIVE SUMMARY

This is the third interim report of the Planning Subcommittee of the FCC's Advisory Committee on Advanced Television Systems. At this juncture, it is appropriate to acknowledge the substantial progress that has been made in the development of an advanced television standard for terrestrial broadcasting. Although research and development into studio standards had been ongoing for more than a decade, very little effort had been expended on broadcast ATV transmission standards until the Commission initiated its Inquiry and empaneled the Advisory Committee in 1987. Today, through the voluntary and cooperative efforts of hundreds of firms and individuals, testing of proponent systems is nearly ready to begin.

Make no mistake, much work remains, especially for those proponents whose pioneering technological efforts will ultimately lead to the next generation of television. But significant headway has also been made in developing a framework for testing and analyzing these proposed systems in a manner that will assist the Federal Communications Commission to reach final judgments as quickly as possible.

This report of the Planning Subcommittee covers work between February 1989 and February 1990. Because much of the Advisory Committee's work has shifted to the Systems Subcommittee, this period has been relatively quiet for most of the Planning Subcommittee's Working Parties. This

diminished activity level is reflected in the progress reports of Working Parties 1, 2, 4, and 5 below.[1]

Three of the Working Parties, Working Party 3 (PS/WP-3 Spectrum Utilization and Alternatives), Working Party 6 (PS/WP-6 Subjective Assessment) and Working Party 7 (PS/WP-7 Audience Research), remain active, however. PS/WP-3, in conjunction with the National Association of Broadcasters, surveyed television chief engineers on auxiliary band usage to establish congestion levels. The Working Party also worked to further define the effect various taboos would have on spectrum availability. In addition, a new Specialist Group was formed to consult and coordinate ATV spectrum plans with Canada and Mexico. Finally, the Working Party briefed system proponents on the nature of interference situations which would have to be accommodated for NTSC/ATV coexistence.

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[1] Advisory Groups 1 and 2 (PS/AG-1 Creative Issues and PS/AG-2 Consumer and Trade Issues) were not active during this period. Working Party 1 (PS/WP-1, Technology Attributes and Assessment) modified the attributes matrix in several respects. Working Party 2 (PS/WP-2, Testing and Evaluation Specifications) specified methodologies for seven of these new items for inclusion in the test parameters plan and referred three items to PS/WP-6 (Subjective Assessment). Working Party 4 (PS/WP-4 Alternative Media Technology and Broadcast Interface) continued its work of monitoring proponent system development and impressing upon the industry the need for broadcast advanced television standards to interface efficiently with non-broadcast media. Working Party 5 (PS/WP-5 Economic Factors and Market Penetration) held a joint meeting with SS/WP-3 to further review the factors affecting market demand and penetration and to discuss the market projections SS/WP-3 requires in conducting its cost studies.

Among the notable achievements of PS/WP-6 during this period was the near completion of work on the creation of the necessary still images and the development of a set of schemes for producing the motion sequences. Moreover, as a result of a reassessment of the requirements for motion sequences, the total number of test segments required has been reduced from 32 to 23 -- nine "still" images and fourteen motion sequences. This refinement will bring important savings in both the resources and time required to produce the motion sequences used for testing. Finally, PS/WP-6 has developed a pair of plans for producing the motion test materials which require the shooting of identical scenes in either two or four formats. Although much of the resources needed to produce these materials has been made available, it has been estimated that roughly $800,000 in cash may still be required. A comparison of the two techniques is scheduled for June 1990.

For its part, PS/WP-7 reviewed and responded to the ATTC study of consumer reactions to letter box displays. In addition, WP-7 issued RFPs for the four study designs it developed previously, from which it received over twenty proposals submitted by more than a dozen research organizations. These proposals were reviewed and responded to and, on the basis of the subsequent interaction between the Working Party and the respondents, PS/WP-7 has concluded that the research program it has developed can be completed

satisfactorily in 12 to 18 months at a cost of perhaps $850,000.

In one fashion or another, each of these three Working Parties has reached a critical point in its deliberations, and they now require guidance from the Advisory Committee in order to progress further. Particularly acute is the need to reach judgments regarding both the production method used to generate the required source material and the funding of that production. Equally important is a decision on the degree of Canadian participation in conducting the subjective tests. These matters must be resolved before any testing can begin.

The testing process does not hinge on providing additional guidance to Working Parties 3 and 7. Nevertheless, the continued effectiveness of both these groups, and the Advisory Committee as a whole, would be enhanced markedly if the Advisory Committee would provide them with guidance on their next phase of work.

Working Party 3 of the Planning Subcommittee (PS/WP-3) has concluded that establishment of actual planning factors must await the interference and coverage data to be developed in the testing program. Nevertheless, sufficient information is available now to create a series of alternative allotment and assignment plans that would offer insights into the tradeoffs posed by various spectrum options. Because the early resolution of some spectrum issues, if possible, would

speed implementation of ATV service, it is recommended that this work be undertaken by the Working Party.

Concurrence by the Advisory Committee on this project is important for two reasons. First, because this work will require a substantial commitment of resources (already generously offered by broadcast members of the Advanced Television Systems Committee), it should not be undertaken without the complete support and endorsement by the Committee. Second, concurrence by the Committee would signify an endorsement of the proposition that detailed allotment and assignment studies should not be deferred until standards have been established.

Finally, Working Party 7 has made a substantial effort in designing a plan of study to ascertain consumer reaction to different aspects of advanced television. It has also developed solid estimates of the cost and time required for these studies. The Committee must now decide whether some, all or none of this research should be undertaken and if so, when it will be conducted and how it will be funded. Insofar as audience tests are not intended to compare attributes of various systems, per se, the Committee may wish to consider deferring these tests until the commencement of field tests.

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I. INTRODUCTION

This is the third interim report of the Planning Subcommittee of the FCC's Advisory Committee on Advanced Television Systems. In it, work performed during the period February 1989 to February 1990 is summarized, the scope of future activity is outlined, and unresolved matters are presented that must be addressed to ensure a timely completion of the Committee's work.

The issues presented by the development of a broadcast advanced television transmission standard are both myriad and complex. Nevertheless, because of the voluntary and cooperative efforts of hundreds of firms and individuals working under the auspices of the Advisory Committee, testing of proponent systems is nearly ready to begin.

The scores of individuals which comprise the Planning Subcommittee have performed an incredible amount of work. During the period covered by this report, the meetings of the seven Working Parties have been attended by more than one hundred members and observers. In addition, several specialist groups, formed by Working Party Chairs, have deliberated on a variety of specific issues. The work of the Subcommittee is reflected in the many documents which have been submitted to the Working Parties and form part of the public record of Planning Subcommittee activities.

The report is organized as follows. The next section summarizes the work of the various Working Parties and Advisory Groups in the previous reporting period. In the third section, the assignments each Working Party and Advisory Group received are summarized. Section four presents a brief progress report of each Working Party, and section five outlines anticipated future work. In section six, special issues requiring the attention of the Advisory Committee are presented. Section seven presents a recapitulation of conclusions and recommendations.

II. BACKGROUND

The achievements of the Planning Subcommittee in the previous phase of their work, covering the period from November, 1988 through February 1989, were fully reported in the Second Interim Report (Appendix B). In brief, they may be summarized as follows:

- Work Party 1 solicited inputs from all of the Subcommittees and Working Parties on new attributes to be added to the 160 already identified. A study was initiated on the quality and number of audio channels needed for ATV that resulted in the deduction of certain minimums that will be required.
- Working Party 2 revised the basic objective test methodology developed in the first phase of work. A recommendation for the treatment of audio for ATV objective testing was achieved.
- Working Party 3 identified the best spectrum scenarios for accommodating ATV in the existing allocations for spectrum requiring contiguous or non-contiguous 3 for 6 MHz assignments and

initiated activities to examine techniques for improving use of the spectrum.

- Working Party 4 completed two major documents: The test plan for rating the suitability of proposed ATV systems in various alternative media; and, 2) a strawman for universal consumer interface called the ATV multiport.

- Working Party 5 studied and projected the probable rate of penetration of ATV service in the U.S.

- Working Party 6 drafted a document which describes the types of psychophysical tests and research methodology which should be employed in making subjective evaluations of ATV picture quality. WP-6 also made substantial progress in planning for the creation of source materials to use in conducting these tests.

- Working Party 7 developed a research plan consisting of four independent studies to determine audience reaction to elements of ATV systems and provide marketing inputs to the ATV standard setting process.

- Advisory Group 1 submitted a report emphasizing the importance of achieving a single world-wide standard for program production and exchange.

- Advisory Group 2 directed it's work to the preparation of the Advisory Committee Report on ATV service to the House Subcommittee on Telecommunications and Finance.

III. NEW ASSIGNMENTS TO WORKING PARTIES FOR THE PERIOD FEBRUARY 1989 THROUGH DECEMBER 1989

At meetings of the Planning Subcommittee Steering Committee held May 17 and September 18, 1989, new work assignments were developed for the various Working Parties. These tasks are summarized below.

A. Working Party 1: Technology Attributes and Assessments

PS/WP-1 was tasked originally with specifying the minimum number of audio channels which proponents should provide in ATV systems. Following the FCC's response to the Advisory Committee's request for guidance on this issue in the Second Interim Report, PS/WP-1's task was modified to notifying proponents of the Commission's view on the matter. PS/WP-1 was also asked to define the attributes of a ghost elimination system for ATV. As in the past, new attributes were to be added to the list as their need becomes apparent to WP-1 or other work parties.

B. Working Party 2: Testing and Evaluation Specifications

Working Party 2 was asked to determine which of the additional ATV attributes defined by PS/WP-1 require testing and develop a methodology for testing those attributes.

C. Working Party 3: Spectrum Utilization and Alternatives

PS/WP-3 was assigned to: 1) Further refine the impact to be expected when "taboos" are/are not eliminated or modified; 2) Determine the spectrum requirements for ATV terrestrial and satellite support distribution systems; 3) Develop the necessary software to show the effect of interference to and from existing NTSC and new ATV services;

4) Develop technical guidelines for ATV spectrum sharing with Canada and Mexico; 5) Identify how interference characteristics of proponent systems impact ATV and NTSC service areas; 6) Study how many existing stations can be assigned an additional 3 MHz or 6 MHz.

D. Working Party 4: Alternative Media Technology and Broadcast Interface

Working Party 4 was asked to continue its studies to determine the practicality of the multiport receiver approach to a universal display interface. In close coordination with Systems Subcommittee WP-2, PS/WP-4 was charged with defining the specific test plans needed to evaluate the effectiveness of proposed alternate media systems. This work will involve specifying "End-to-End" testing of ATV systems under field conditions.

E. Working Party 5: Economic Factors and Market Penetration

Working Party 5, in coordination with SS/WP-3 (Economic Assessment), was asked to prepare a report on the impact of proponent systems on domestic economies.

F. Working Party 6: Subjective Assessment

PS/WP-6 was tasked with conducting a detailed evaluation of the test of two approaches being considered for producing the subjective test material. In addition, PS/WP-6 was asked

to evaluate any new test material preparation proposals that may be put forward, coordinate the production of the test material, re-examine the previously identified test scenes to ensure that all are required, and prepare a recommendation on the still picture scenes.

G. Working Party 7: Audience Research

PS/WP-7 was asked to: 1) Finalize the audience research plan and prepare budgets and time schedules to conduct the audience research testing; 2) Identify possible sources for funding the proposed research; 3) Coordinate with the Advanced Television Test Center (ATTC) on research into audience reactions to so-called "letter box displays."

IV. PROGRESS REPORT OF THE PLANNING SUBCOMMITTEE

This section summarizes the progress made by the seven working parties in the period February 1989 to December 1989.[2]

A. Progress Report of Working Party 1: Technology Attributes and Assessment

In response to the new projects with which PS/WP-1 was tasked, the Working Party was reconvened, and meetings were held on July 6 and September 20, 1989.

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[2] The two advisory groups within the Planning Subcommittee were inactive during this period.

"At the first meeting, the working party members agreed that an ATV service needs to have an audio service of near CD stereo quality, noting that such a recommendation did not necessarily imply support of any particular implementation. It was further noted that a near CD stereo quality audio service did not necessarily imply a digital stereo pair in addition to the NTSC stereo service. It might be possible to accomplish the same by other means such as a digitally assisted audio (DAA) implementation.

"The members of WP-1 still strongly believe that the number of sound or data channels and the methodology by which they are achieved should be a choice of the system proponents.

"During the first meeting, it was further agreed that a service survey should be undertaken to determine what services in addition to a stereo audio service might be provided. Such additional services to include SAP, analog or digital data service, etc. WP-1 is currently initiating such a survey. A report will be issued when the results have been completed.

"The request to define the attributes of an ATV system required for ghost cancelling were discussed and then finalized during the second meeting. Additional attributes were also added to the matter list. The additional attributes are as follows:

- Ghost Cancelling: Attributes were added as section 2.10.4.1 through 2.10.4.5 supplemented by an additional paragraph to section 6.3 on page 9 of the notes.

- IDTV Pre-filtering: Attributes covering the issue of temporal and spatial prefiltering of compatible NTSC signals appear as sections 2.11.1 through 2.11.4 and 6.7.4.

- Collocation/Non-collocation: Contours appear as section 6.12.1 and 6.12.2.

- The question of sync ruggedness resulted in the addition of sections 6.2.1, 6.2.2, 6.13 and 8.5.

- The attributes list on ATV Audio was amended to include a note after attribute 3.3 and a new attribute 3.8.1.

- WP-1 added section 6.14 on Non-flat transmission paths.

- WP-1 also added section 1.5 on Video "cuts".

- The question of camera steadiness resulted in a note being added to section B covering section 1.1.

- Attributes were added concerning bit and symbol errors in sections 5.3.1 through 5.3.4.

- The question of base band format compatibility is addressed by adding section 7.5.

The revised attributes matrix and accompanying notes was [sic] reissued as document PS/WP-054."[3]

B. Progress Report of Working Party 2: ATV Testing and Evaluation Specifications

PS/WP-2 was reactivated to review additional attributes defined by PS/WP-1 at their September 20, 1989 meeting.

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[3] This summary was quoted verbatim from the PS/WP-1 Chairman's Report.

PS/WP-2 held a meeting via teleconference on November 29, 1989 to identify the attributes to be tested and delegate responsibilities for providing inputs to the test plan.

The Chairman's report details the additions and corrections to the ATV Test and Evaluation Specifications that resulted. Three items (video cuts, video peaking and camera unsteadiness) were referred to and accepted by PS/WP6 as subjective assessments for the expert viewing panel. Methodologies for seven items (ghost cancellation, transmitter collocation, sync ruggedness, digital audio, level versus frequency response, non-flat transmissions frequency response and bit/symbol errors) were specified for inclusion in the test parameters plan. One final item (prefiltering) was addressed, and an input document received (appended to the Chairman's report), but no test methodology was developed for inclusion in the test plan.

C. Progress Report of Working Party 3: Spectrum Utilization and Alternatives

This Working Party advanced its tasks of identifying radio spectrum which could be used by proponent ATV systems through a variety of activities. These were accomplished through its specialists groups. Specialist Group #3 -- Support Allocations -- is examining TV auxiliary service requirements (e.g., STL, ENG). Specialist Group #4 -- Spectrum above 1 GHz -- is considering the possibility of establishing additional ATV broadcast allocations outside of

the VHF and UHF bands. Specialist Group #6 -- Spectrum Scenarios -- is examining the availability of UHF and VHF channels under various technical scenarios. Specialist Group #7 -- Taboos -- is analyzing the effect assignment taboos could have on spectrum availability. Specialist Group #9 is charged with coordinating spectrum use with Canada and Mexico.

Through the conduct of several surveys in conjunction with NAB, Specialist Group 3 was able to determine the potential impact of requiring additional auxiliary spectrum to support ATV stations. The information was compiled from surveys of existing frequency users and coordinators in the bands. The results of these studies indicate that the television auxiliary bands are crowded, and either more TV auxiliary spectrum is needed or non-spectrum alternatives need to be developed.

The effort of Specialist Group 4 to identify possible additional broadcast allocations outside the VHF and UHF bands was deferred pending evaluation of propagation tests being conducted by the ATTC.[4] It was felt that the results of these tests were necessary to make a more definitive

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[4] The FCC has tentatively concluded not to allocate additional spectrum to broadcast television for the provision of ATV. See, Advanced Television Systems, Tentative Decision and Further Notice of Inquiry, MM Docket 87-268, 3 FCC Rcd 6520 (1988). Specialist Group #4 was nevertheless formed because of a recognition that circumstances might be such that the Commission may wish to revisit that tentative conclusion.

determination with regard to the utilization of frequencies above 1 GHz.

Specialist Groups 6 and 7 worked together to further define the impact of taboos on availability of spectrum. Previously, the analyses done by Specialist Group 6 had determined availability of spectrum based only on cochannel and adjacent channel interference -- i.e., taboos were ignored. Several graphs indicating this availability were produced based on the assumption that proponent systems would be able to co-exist within the existing NTSC allotment structures. This cannot be verified until actual tests are done on the proponent system characteristics.

An important attribute is the ability of an ATV system to utilize the taboo spectrum and neither cause nor receive unacceptable interference to and from NTSC systems. To determine the impact of having to accommodate some taboos, the Specialist Groups 5, 6, and 7 during this period devised a series of analyses to be performed to explore the effect of both individual and multiple taboos. The accomplishment during this period was to define the tests and take steps to develop the software to carry them out. These impact analyses will require approximately 300 computer runs. This will be accomplished as a result of resources committed by the Broadcasters' Caucus of the Advanced Television Systems Committee. In this connection, steps were taken to obtain a

computer/software modelling capability, and obtain the FCC program for spectrum scenario modelling.

Specialist Group 9 was newly established to begin the necessary consulting and coordination with respect to use of spectrum for ATV along the Canadian and Mexican borders. To this end an initial meeting was held between representatives of Canadian and U.S. Working Groups on ATV Spectrum to establish a Joint Task Force. This Joint Task Force has agreed to:

- Analyze and compare the results of the spectrum studies completed to date in both the United States and Canada;
- Develop joint spectrum scenarios for introducing advanced television systems;
- Perform joint spectrum studies to determine the availability of spectrum for ATV under the various spectrum scenarios;
- Propose technical planning factors for an ATV service for the different spectrum scenarios;
- Propose technical guidelines for sharing of the VHF/UHF spectrum for ATV along the U.S./Canadian border.

Subsequent to carrying out the studies indicated above the Working Party has decided to next focus its energies on the development of Planning Factors which can be used to construct a nationwide allotment table for recommendation to the FCC as a principal contribution of the Advisory Committee.

Finally, the working group conducted an extensive briefing for representatives of the proponent systems. An outline of the subjects covered is contained at in an appendix to the WP-3 report. The briefing was intended to clarify for the proponent systems organizations the nature of the interference situations which would have to be accommodated in order for NTSC and ATV to co-exist.

D. Progress Report of Working Party 4: Alternative Media Technology and Broadcast Interface[5]

Working Party 4 met three times in 1989, each meeting attended by 25 members. The prior report to the Planning Subcommittee included two major documents:

1) the test plan for rating the suitability of proposed ATV systems in various alternative media;
2) a strawman for universal consumer interface called the ATV multiport.

These documents were intended to establish guidelines and prompt further work. After about one year of industry-wide circulation, these documents were integrated (either partly or in whole) in various activities. For example, Cable Labs and ATTC now incorporate most of our conceptual test plans. Other industry organizations such as ATTC, Cable Labs, NCTA, EIA, AEA, ATSC, SS/WP-4 (standards) are also studying the ideas and issues originally presented in the Working Party's

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[5] With only minor alterations, this summary is quoted verbatim from the PS/WP-4 Chairman's Report.

ATV multiport document. Consequently, PS/WP-4 reports that it has impressed to the television industry a higher level of awareness on the need for broadcast ATV to efficiently interface with alternatives media.

During the week of May 8, 1989, in the midst of the SS/WP-1 marathon meetings, PS/WP-4 requested information (verbally and by a questionnaire) on how ATV proponents contemplate interfacing with alternative media. Only Zenith has as yet provided a written response. For this reason, the drafting of a technical report on the expected performance of proposed ATV systems with alternate media was deferred.

Most PS/WP-4 members now believe that once the FCC standardization process is completed, and if the chosen standard offers significant operational and technical improvements, then alternative media will likely carry such ATV standard. If no improvement is perceived, then it is reasonable to expect that alternative media will consider another transmission format.[6] However, PS/WP-4 believes that it would be disruptive if alternative media adopt an ATV standard before the FCC does, and this scenario is generally discouraged.

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[6] The FCC has tentatively concluded not to retard the introduction of advanced television technologies on non-broadcast media. See, Advanced Television Systems, Tentative Decision and Further Notice of Inquiry, MM Docket 87-268, 3 FCC Rcd 6520 (1988).

E. Progress Report of Working Party 5: Economic Factors and Market Penetration

Working Party 5 continued to respond to the needs of Systems Subcommittee Working Party 3 (SS/WP-3 Economic Assessment). To that end, Working Party 5 held a joint meeting with SS/WP-3 on October 30, 1989 to further review the factors affecting ATV market demand and penetration and to discuss the market projections needed as inputs to SS/WP-3's cost studies. Subsequently, PS/WP-5 considered the adoption of the VCR as the most useful model for projecting ATV market penetration, and will appropriately draw on experience from this and other past product introductions for the on-going study.

F. Progress Report of Working Party 6: Subjective Assessment of ATV Systems

PS/WP-6 made substantial headway toward developing the picture materials needed to conduct the subjective tests, and so long as the funds needed to produce the motion sequences are available in a timely fashion, it is anticipated that these materials will be delivered to the ATTC by September 1, 1990 -- in advance of the start of system tests.

The required still test material is nearly completely collected and/or photographed and is undergoing final review.[7] As a result of a careful reassessment of the

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[7] The descriptions of content of the stills and (continued...)

requirements for motion sequences, the total number of segments required has been reduced from 32 to 23 -- nine "still" images and fourteen motion scenes.[8] PS/WP-6 has concluded that test results will in no way be compromised by using this smaller set of materials, and substantial savings in the time and resources needed to produce the materials will be realized.

With regard to the motion sequences used for testing, PS/WP-6 has reached two conclusions. First, the most important motion sequences -- those generated by an electronic camera -- will be produced by one of the following two methods:

1. Sequentially produced "identical" picture material in four scanning formats (525-line progressive, 787.5-line progressive, 1050-line interlace, and 1125-line interlace) using a BTS KCH-1000 multiscan camera.

2. "Identical" picture material produced for 1050-line interlace and 525-line progressive formats by standards-converting an 1125-line interlace signal. "Identical" picture material produced in the 1125-line interlace and 787.5-line progressive formats using the BTS KCH-1000.

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[7](...continued)
motion sequences have been agreed upon by the Working Party following drafting by specialists. Final approval of each still or motion sequence will follow examination of the as-produced materials. Most of the still images were generously donated by Eastman Kodak and the National Aeronautics and Space Administration.

[8] PS/WP-6 has defined the test material as these nine still images and fourteen motion scenes, edited into two randomized groupings of ten second sequences.